

**ABSTRACT OF THE DISCLOSURE**

Steam generation apparatus and methods are presented that are dedicated to oxygen-enriched air combustion of a fuel, wherein the oxygen concentration of the oxygen-enriched air may range from just above 21 percent to 100 percent. One apparatus comprises an oxygen-enriched air preheater through which oxygen-enriched air flows and exchanges heat indirectly with flue gas, creating a preheated oxygen-enriched air stream. The apparatus further comprises a boiler having a radiant section and a convection section, and other heat transfer units adapted to handle reduced flue gas flow rate and higher temperature flue gases than comparable air/fuel combustion boilers, thus allowing a smaller heat transfer surface area, a more compact design and a higher efficiency.

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